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CARROLL EMORY WOOD, JR. } Associate Editors

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ASA GRAY AND ANDREW JACKSON DOWNING: A BIBLIOGRAPHICAL NOTE

A. HUNTER DUPREE

ALTHOUGH he labored for thirty years as director of Harvard's Botanic Garden, Asa Gray published little on horticulture, and his work in botany completely overshadowed the garden side of his career. An early publication,¹ however, which does not appear in the standard list of Gray's published works,² connects him both with horticulture and with Andrew Jackson Downing, its most important devotee in the pre-Civil War United States. In 1841, Wiley and Putnam of New York published, under the editorship of Downing and Gray, the first American edition of John Lindley, *The Theory of Horticulture*.

Since Gray was in New York in 1841 he doubtless knew the young landscape gardener who lived on the Hudson River. And since the firm of Wiley and Putnam was the publisher both of Gray's *Botanical Textbook* and Downing's *Treatise on the Theory and Practice of Landscape Gardening*, the origin of the collaboration is easy to visualize. Each editor signed the notes he added. Downing usually discussed practical problems of gardening in the United States, while Gray supplied data on American climate and also comments concerning plant physiology in terms similar to the 1842 edition of the *Botanical Textbook*, on which he was working at the time.

¹ JOHN LINDLEY, *The Theory of Horticulture: or, an Attempt to Explain the Principal Operation of Gardening upon Physiological Principles* (First American edition, with notes, etc., by A. J. Downing and A. Gray, N. Y., 1841).

² [SERENO WATSON and G. L. GOODALE], "List of the Writings of Dr. Asa Gray, Chronologically Arranged, with an Index," *American Journal of Science*, 3rd ser., XXXVI (1888), Appendix, 3-67.

The appearance of this American edition of the British botanist Lindley's work on horticulture illustrates two important tendencies in plant science in the United States about the year 1840. In the first place, it was a part of the campaign waged by Gray and John Torrey to bring American botany abreast of current European theory.³ In the second place, the book is a part of the first great effort to apply science to American agriculture and horticulture. The translation of Justus Liebig's epochal work on agricultural chemistry appeared in the United States in the same year of 1841.⁴ Gray explicitly recognized the importance of Liebig's work in a footnote to Lindley's chapter on soil and manure, where he said, "These remarks were perfectly applicable when this work was published (early in 1840); but the treatise on *Organic Chemistry in its application to Agriculture and Physiology*, by the distinguished Professor Liebig, which appeared a few months later, has greatly elucidated the whole subject."⁵ The immediate popularity of Liebig's work perhaps accounts for the obscurity into which the American edition of Lindley soon fell.

That Gray and Andrew Jackson Downing worked together as young men has a certain importance to the later history of horticulture and landscape gardening in the United States. Their collaboration seems to have ceased when Gray moved to Cambridge in 1842, but Downing in the next few years laid the basis for a brilliant and pioneering career in landscape architecture. He had just begun to lay out the Smithsonian Institution grounds in Washington when he died in 1852 at the age of thirty-seven while rescuing victims of a steamboat disaster on the Hudson.⁶ His influence nevertheless lived on and was definitely present in the planning of the Arnold Arboretum, established in 1872.

Back in 1841 Downing had personally presented a copy of his *Treatise on the Theory and Practice of Landscape Gardening* to Asa Gray.⁷ In 1859, after Downing's death, his neighbor and

³ The better known example is JOHN LINDLEY, *A Natural System of Botany* (First American edition, with an appendix by John Torrey, N. Y., 1831).

⁴ See Liebig and After Liebig: *A Century of Progress in Agricultural Chemistry* (Washington, 1942).

⁵ LINDLEY, *Theory of Horticulture* (American edition), 314 n.

⁶ HERBERT A. KELLAR, "Andrew Jackson Downing," *Dictionary of American Biography*, V, 417-418.

⁷ Presentation copy in Gray Herbarium Library.

follower, Henry Winthrop Sargent, brought out a sixth edition of the same work with a supplement describing Wodenethe, his own estate on the Hudson, and also the estate of this relative, Horatio Hollis Hunnewell, of Wellesley, Massachusetts.⁸

It was Henry W. Sargent who first kindled the interest of both Hunnewell and his younger relative, Charles Sprague Sargent, in horticulture and landscape gardening.⁹ Thus of the men who played major roles in the institutional rearrangements of Harvard in 1872 out of which the Arnold Arboretum grew, three—Gray, Hunnewell, and C. S. Sargent—had long acquaintance with the tradition stemming from the work of Downing. Frederick Law Olmsted, an old friend of Gray's and the co-worker with C. S. Sargent in laying out the Arnold Arboretum, also owed much to the influence of Downing. Hence the founders of the Arboretum in the 1870's had the benefit of a horticultural tradition, of which they were a part, going back thirty years to New York state and Andrew Jackson Downing, and the collaboration of the two co-editors of the American edition of Lindley's *Theory of Horticulture* bore fruit after many seasons.—UNIVERSITY OF CALIFORNIA, BERKELEY.

ADDITIONS TO THE FLORA OF ST. PAUL ISLAND, NOVA SCOTIA

J. S. ERSKINE

ST. PAUL ISLAND is the northernmost point of Nova Scotia, a cliffbound island three and one-quarter miles long by never more than one mile wide. The vascular flora was first listed by Dr. A. H. MacKay in 1883. Then in 1929 Miss L. M. Perry and Dr. Muriel Roscoe spent a month on the island and collected exhaustively the vascular plants and the algae, lists of which appeared in *Rhodora* in May, 1931. The present author spent from August 10th to 17th on the island, collecting plants for the Nova Scotia Museum of Science. Miss Perry's lists and floristic descriptions are still valid today, although

⁸ See C. S. SARGENT, "Henry Winthrop Sargent," L. H. Bailey, ed., *Standard Cyclopedia of Horticulture* (N. Y., 1915), III, 1504.

⁹ E. W. SARGENT and C. S. SARGENT, eds., *Epes Sargent of Gloucester and his Descendants* (Boston, 1923), 193.

many of her plant-names have been changed and some varieties discarded. As all these alterations can be traced through Gray's *Manual of Botany*, 8th Edition, I have not thought it worthy of space to comment upon them and I offer this list merely as a supplement to hers. When new varietal retinements have seemed of interest, I have included them in my list. The vascular collections have been checked completely by D. S. Erskine in the N. S. Museum, and in part by others, and I have accepted their determinations when their judgement has disagreed with mine. The chief differences between Miss Perry's list and mine, apart from the fluctuating element of introduced and often impermanent weeds, suggest that she combed the bare headlands more thoroughly, I the woods and bogs. Her list showed 280 species and 17 still accepted varieties, mine 290 species and 6 varieties, the combined total being 320 species thus far known for the island.

ADDITIONS TO MISS PERRY'S LIST

1. *Lycopodium complanatum* L., var. *flabelliforme* Fern. One station, Atlantic Cove by path to Big Lake.
2. *Picea mariana* (Mill.) BSP. Many stunted trees in bogs.
3. *Potamogeton confervoides* Reichenb. Sterile in Little Lake.
4. *Festuca elatior* L. Scarce weed by road to Southwest.
5. *Poa annua* L. Clumps around barn, Southwest.
6. *Poa palustris* L. Headland, Southwest.
7. *Agropyron repens* (L.) Beauv., var. *subulatum* (Schreb.) Reichenb., f. *Vaillantianum* (Wulf. & Schreb.) Fern. Garden, Atlantic Cove.
8. *Agropyron trachycaulum* (Link.) Malte, var. *novae-angliae* (Scribn.) Fern. Headlands, Atlantic Cove & Petrie's Point.
9. *Hordeum jubatum* L. Salty hilltop, Northeast.
10. *Elymus mollis* Trin. Headland, Martin Power's Cove.
11. *Agrostis scabra* Willd. Roadside to Southwest.
12. *Agrostis tenuis* Sibth. Wood-edge, Atlantic Cove.
13. *Hierochloa odorata* (L.) Wahl. Boggy slope, Trinity Cove.
14. *Eleocharis halophila* Fern. Brackish pool on NE Head.
15. *Eleocharis Smallii* Britt. Edge of Little Lake. Probably Miss Perry's *E. palustris* was this alone and not 14.
16. *Eriophorum spissum* Fern. Occasional in bog, Petrie's Pond.
17. *Carex cephalantha* (Bailey) Bickn. Swamp by path to Northeast.
18. *Carex leptalea* Wahl. Wood near Little Lake.
19. *Carex novae-angliae* Schwein. Wood, Atlantic Cove.
20. *Carex salina* Wahl. (\times *C. paleacea* Wahl. ?DSE)
21. *Carex pallescens* L., var. *neo-gaea* Fern. Petrie's Pond.

22. *Carex oligosperma* Mx. Frequent in high bogs, Coggin's Mtn.
23. *Juncus pelocarpus* Mey. Floating in bog-pool, SW Head.
24. *Smilacina trifolia* (L.) Desf. Frequent in bog-holes.
25. *Habenaria Hookeri* Torr. Wood, Atlantic Cove.
26. *Habenaria blephariglottis* (Willd.) Torr. Common on high bogs, Coggin's Mtn.
27. *Goodyera repens* (L.) R. Br., var. *ophioides* Fern. In woods, Norwegian Mtn., Coggin's Mtn., SW Head.
28. *Salix Bebbiana* Sarg. Three sterile shrubs from scattered stations.
29. *Myrica Gale* L. Common around bog-holes.
30. *Betula lutea* Mx. f. Rare shrubs with unusual leaves.
31. *Betula papyrifera* Marsh., var. *commutata* (Regel) Fern. and var. *macrostachya* Fern. The species was reported by Miss Perry. These varieties are recognizable among a jumble of variants.
32. *Betula borealis* Spach. In alder scrub by path to NE and on high bogs, Coggin's Mtn.
33. *Betula pumila* L., var. *renifolia* Fern. Found by Miss Perry and later segregated to this variety.
34. *Rumex domesticus* Hartm. Hen-run, Atlantic Cove.
35. *Cerastium arvense* L., var. *viscidulum* Greml. Found by Miss Perry and now segregated into this variety.
36. *Neslia paniculata* (L.) Desv. Hen-run, Atlantic Cove.
37. *Drosera intermedia* Hayne. Common around edge of bog-holes.
38. *Pyrus americana* Marsh. Miss Perry found only *P. decora*, but my collections were nearer to *P. americana*.
39. *Prunus virginiana* L. Occasional in wood, Atlantic Cove; forming scrubby woods west of Big Lake.
40. *Vicia Cracca* L. Rare weed, Atlantic Cove.
41. *Hypericum perforatum* L. Beside road to Southwest.
42. *Oenothera biennis* L. Spreading weed, Atlantic Cove.
43. *Sanicula marilandica* L. Wood west of Big Lake.
44. *Coelopleurum lucidum* (L.) Fern. Headland, Martin Power's Cove.
45. *Cornus* \times *unalaschkensis* Ledeb. Reported but not collected by Miss Perry. Fairly frequent.
46. *Cornus alternifolia* L. f. Wood near Little Lake.
47. *Monotropa Hypopitys* L. One patch on Coggin's Mtn.
48. *Bartonia paniculata* (Mx.) Muhl., var. *sabulonensis* St. J. & Fern. Not uncommon in bog, Petrie's Pond & Coggin's Mtn.
49. *Lappula echinata* Gilib. By barn, Southwest.
50. *Achillea Millefolium* L. was found by Miss Perry, but my specimens have been corrected to *A. lanulosa* Nutt.
51. *Matricaria maritima* L. By barn, Southwest.
52. *Sonchus arvensis* L. Headland, Northeast.
53. *Sonchus asper* (L.) Hill. Roadside to Southwest.
54. *Lactuca biennis* (Moench.) Fern. Occasional in east woods.
55. *Hieracium aurantiacum* L. One plant, Atlantic Cove.
56. *Hieracium canadense* Mx. Established by road to Southwest.

The bryophytes of St. Paul Island have not previously been listed. The island, with its woods, bogs and raw headlands, is a better habitat for mosses than for vascular plants, yet only one species of moss to six of vascular plants was collected as compared to one to four on the mainland. This list, therefore, cannot claim to be exhaustive. The more difficult mosses and hepatics were checked by Dr. A. L. Andrews of Ithaca, N. Y., the sphagna by Dr. H. L. Blomquist of Duke University, and my thanks are due to both of them. Twenty species of lichens were collected also, but, as these have not been checked by an authority and as they do not differ appreciably from those of the Cape Breton barrens, the names are not listed here.

HEPATICS

- Barbilophozia barbata* (Schmid.) Loeske. 2417, Atlantic Cove.
Bazzania trilobata (L.) S. F. Gray. 2411, Woods, Little Lake.
Blasia pusilla L. 2360, 2436. SW Head, Norwegian Mtn.
Blepharostoma trichophyllum (L.) Dum. 2375, path to NE.
Calypogeia Neesiana (M. & C.) K. Mull. 2415, Atlantic Cove.
Calypogeia Trichomanis (L.) Corda. 2360, Southwest Head.
Cephalozia bicuspidata (L.) Dum. 2436, Norwegian Mtn.
Cephalozia connivens (Dicks.) Lindb. 2436, Norwegian Mtn.
Cephalozia leucantha Spruce. 2436, Norwegian Mtn.
Cephaloziella hampeana (Nees) Schiffn. 2438, Path to NE.
Harpanthus scutatus (Web. & Mohr) Spruce. 2460, Southwest Head.
Lepidozia reptans (L.) Dum. 2416, Atlantic Cove.
Lophozia grandiretis (Kaal) Schiffn. Southwest Head.
Scapania irrigua (Nees) Dumort. 2418, 2459, SW Head, Atlantic Cove.

MOSSES

- Aulacomnium palustre* (Web. & Mohr) Schwaegr. 2368, South Shore.
Amblystegium compactum (C. Müll.) Aust. 2420, woods, SW Head.
Atrichum undulatum (Hedw.) Beauv. 2427, Norwegian Mtn.
Brachythecium salebrosum (Web. & Mohr) Bry. Eur. 2372, 2379, swampy woods, South Shore.
Bryum pallens (Web. & Mohr) Brid. 2380, wet rocks, path to NE.
Ceratodon purpureus (Hedw.) Brid. 2351, 2358, 2400, 2425. Outcrops, Norwegian Mtn., SW Head, Atlantic Cove.
Dicranella heteromalla (Hedw.) Schimp. Humus in wood, SW Head.
Dicranella subulata (Hedw.) Schimp. 2394, path to NE.
Dicranum Bergeri Blan. 2398, 2450. Atlantic Cove, Coggin's Mtn.
Dicranum Bonjeani DeNot. Humus in wood, SW Head.
Dicranum Drummondii C. Müll. 2354, 2379, 2445. Humus in wood, Norwegian Mtn.; SW Shore; slope by Petrie's Pond.
Dicranum scoparium Hedw. 2392, 2408, 2413, 2420, 2448. Woods, Path to NE, Little Lake, Trinity Cove, Coggin's Mtn.

- Drepanocladus fluitans* (Hedw.) Warnst. 2422, 2426. Bog, SW Head, Norwegian Mtn.
- Drepanocladus revolvens* (Sw.) Warnst. 2378, Bog by path to NE.
- Fontinalis novae-angliae* Sull. 2406, in Little Lake.
- Grimmia maritima* Turn. 2431, rocks, Trinity Cove.
- Hylocomium splendens* Hedw. 2412, rare, woods by Little Lake.
- Hypnum pallescens* (Hedw.) Bry. Eur. 2353, tree bole, Norwegian Mtn.
- Leptodictyum riparium* (Hedw.) Warnst. 2390, bog-pool, SW Head.
- Mnium hornum* Hedw. 2364, 2370, 2356. Rocks, SW Head.
- Mnium punctatum* Hedw. 2414, 2451. Atlantic Cove, Coggin's Mtn.
- Pohlia nutans* (Hedw.) Lindb. 2377, 2397, 2444. Common.
- Plagiothecium striatellum* (Brid.) Lindb. 2383, Rock talus, SW Head.
- Pleurozium Schreberi* (Brid.) Mitt. 2407, by Little Lake, rare.
- Polytrichum gracile* Smith. 2409, woods by Little Lake, rare.
- Polytrichum juniperinum* Hedw. 2388, 2446, Bog, SW; path, NE.
- Rhytidiadelphus squarrosus* (Hedw.) Warnst. 2387, 2410, Little Lake, SW Head.
- Sphagnum capillaceum* (Weiss.) Schrank., var. *tenellum* (Schimp.) Andrews. 2447, Coggin's Mtn.
- Sphagnum centrale* C. Jens. 2424, Big Lake. det. A. L. Andrews.
- Sphagnum compactum* DC. 2366, SW Head.
- Sphagnum cuspidatum* Ehrh. 2391, SW Head.
- Sphagnum fimbriatum* Wils. 2369, boggy SW shore.
- Sphagnum fuscum* (Schimp.) H. Klingr. 2395, 2449. Bogs.
- Sphagnum Girgensohnii* Russ. 2374, wet woods, South Shore.
- Sphagnum imbricatum* Hornsch. 2384, SW Head.
- Sphagnum Lindbergii* Schimp. 2381, Big Lake.
- Sphagnum magellanicum* Brid. 2428, Norwegian Mtn.
- Sphagnum papillosum* Lindb. 2365, SW Head.
- Sphagnum recurvum* Beauv. 2419, 2429. Atlantic Cove; Norwegian Mtn.
- Sphagnum riparium* Angst. 2389, SW Head.
- Sphagnum squarrosus* Crome. Wood, SW Head.
- Sphagnum tenellum* Pers. 2386, SW Head.
- Sphagnum Warnstorffii* Russ. 2396, bog by path to NE.
- Tetraphis pellucida* Hedw. 2435, Norwegian Mtn.
- Ulota crispa* (Hedw.) Brid. 2352, tree-trunk, Norwegian Mtn.
- Ulota phyllantha* Brid. 2434, Norwegian Mtn.

Of these only two are new Nova Scotian records. *Sphagnum riparium* Angst. is to be expected here but has not hitherto been reported. *Sphagnum centrale* C. Jens. has not usually been found near the coasts but is otherwise within its expected range. Dr. Andrews said that this specimen lacked the usual robustness of this species.

I have to give grateful acknowledgement of assistance to the Nova Scotia Museum of Science for financing the expedition, to Dr. Andrews and Dr. Blomquist for determinations, and to Miss Perry for having provided an excellent list to build on.—WOLFVILLE, NOVA SCOTIA.

A CYTOTAXONOMIC STUDY OF THE GENUS
HYMENOPAPPUS (COMPOSITAE)

BILLIE L. TURNER

(Continued from page 242)

3l. *Hymenopappus filifolius* var. *idahoensis*, var. nov.

Herbae perennes, caulibus 0-2-foliatis 10-45 cm. altis; foliis inferioribus bipinnatis sparse tomentosis glabratissimis, 6-15 cm. longis, 3-5 cm. latis, segmentis remotis 8-20 mm. longis, 1-2 mm. latis; inflorescentiis 4-14 capitulatis; flosculis flavis 3.2-4.5 mm. longis, fauce 1.5-2 mm. longa; pappo 0.7-1.3 mm. longo.

Plants perennial, 15-45 cm. high, mostly glabrate to sparsely tomentose, except in the axils of the rosette leaves which are densely woolly; principal rosette leaves 6-15 cm. long, 3-5 cm. wide, glabrous to sparsely tomentose, sparsely bipinnately dissected with relatively broad, flattened, linear divisions, mostly 8-30 mm. long, 1-2 mm. wide; stem leaves 0-2, much reduced; heads 4-14 per stem, campanulate, 25-70 flowered (rarely less), on nearly glabrate ultimate peduncles 1-6 cm. long; principal involucre bracts 7-9 mm. long, 3-4 mm. wide, mostly glabrate, or nearly so, yellow-membranous (very rarely reddish) for 1-2 mm. from the acute tip; corollas bright yellow, 3.2-4.5 mm. long, the tube moderately glandular, 1.5-2.5 mm. long, the throat campanulate, 1.5-2 mm. long with lobes reflexed, 3-4 times as long as the lobes; achenes 4.5-6 mm. long, pubescent with hairs about 1 mm. long; pappus of 12-16 linear oblong scales, 0.6-1.3 mm. long; anthers partly exserted, 2.5-3 mm. long; $n = 17$. TYPE (ws): Idaho. Lemhi Co.: Junction of Warm Spring Cr. and Salmon R. (about 14 mi. S. of Salmon); rusty-red, sandy-silty hill slopes, June 12, 1951, *S. J. Preece & B. L. Turner 2378* (Isotypes to be distributed).

DISTRIBUTION.—Known only from Idaho along the Salmon and Big Lost Rivers in Custer and Lemhi counties where it occurs on low rocky, gravelly, or sandy foothills (Fig. 28). June-July.

Hymenopappus filifolius var. *idahoensis* is a poorly defined variety that has been segregated primarily on its geographical isolation and secondarily on its combination of rather minute differences (cf. Table 1, p. 218). The variety would probably be considered no more than a race of var. *nanus* were it included in the range of that taxon; however, it may be distinguished from that variety by being less pubescent throughout, having more numerous heads on shorter peduncles, shorter pappus, and longer, more flattened, thicker ultimate leaf segments.

At the type locality, specimens of var. *idahoensis* that superficially resemble var. *nanus* (smaller, more pubescent plants, with fewer heads) may be found growing on rocky hilltops.

The character of the pappus is seemingly constant, however, and the degree of resemblance is merely an approach.

REPRESENTATIVE SPECIMENS.—**Idaho.** CUSTER CO.: Below Clayton, *R. J. Davis* 486 (ds, ws); 10 mi. N. E. of Clayton, *Hitchcock* 15668 (rsa, uc, ws); low hills across river from Challis, *Hitchcock & Muhlick* 8958 (cas, gh, mo, rm, smu, ws); Challis Cr., *Macbride & Payson* 3338 (cas, gh, mo, ny, pom, rm, uc, us); Mackay, *Nelson & Macbride* 1561 (ds, gh, mo, rm). LEMHI CO.: about 15 mi. S. of Salmon, *Hitchcock, Rethke & van Raadshooven* 3726 (cas, ds, gh, uc, ws); Junction of Box Cr. and Salmon R., 16 mi. S. of Salmon, *Preece & Turner* 2387 (smu, ws).

3m. *Hymenopappus filifolius* var. *cinereus* (Rydb.) Johnston

Hymenopappus cinereus Rydb. Bull. Torr. Bot. Club 27: 634. 1900. *Hymenopappus filifolius* var. *cinereus* Johnston, Contrib. Gray Herb. 68: 98. 1923. Type examined (NY): Colorado. Walsenberg, 1800 m., June 5, 1900, *P. A. Rydberg & F. K. Vreeland* 5479.

Hymenopappus arenosus Heller, Bull. Torr. Bot. Club 25: 200. 1898. Isotypes examined: New Mexico. Santa Fe Co.: near Espanola, 5600 ft., May 17, 1897, *A. A. & E. G. Heller* 3542.

Hymenopappus ochroleucus Greene, Plantae Bakerianae 3: 30. 1901. Isotypes examined: Colorado, Cimarron, 6900 ft., June 28, 1901, *C. F. Baker* 269. In the original description Greene cited only the following specimens, "C. F. Baker, 25 and 269." Material of collection number 269 is widely distributed in herbaria and should serve as the type, instead of collection number 25 which was not found in the specimens examined by the author.

Plants perennial, 15–40 cm. high, sparsely grayish-green tomentose; principal rosette leaves 5–14 cm. long, bipinnately dissected with linear, filiform divisions, 0.5–1 mm. wide, conspicuously impressed-punctate; stem leaves (0–)2–4, much reduced upwards; heads 1–6 per stem, subturbinate to campanulate, 25–40 flowered, on ultimate peduncles 1–6 cm. long; principal involucre bracts 6–9 mm. long, 2–4 mm. wide, glabrous to densely tomentose, yellow or rarely white-membranous for 1–2(–3) mm. from the acute to obtuse tip; corolla yellow or rarely white (ochroleucous), 3–4.5 mm. long, the tube moderately glandular, 1.5–2.5 mm. long, the throat campanulate 1.5–2.5 mm. long with lobes reflexed, 2.5–4 times longer than the lobes, achenes 4–6 mm. long, evenly pubescent with conspicuous hairs 1–3 mm. long; pappus of 14–18 linear oblong scales, 1.5–2 mm. long; anthers partially exerted 2–3 mm. long; $n = 17$.

DISTRIBUTION.—Rocky Mountains, in exposed situations at mid-elevations (5,500–10,000 ft.), Colorado, eastern Utah, central and northern New Mexico, and northeastern Arizona, with outliers in the rocky, limestone canyons of the northern panhandle of Texas, and in White Sands National Monument, New Mexico (Fig. 37). May–September.

Hymenopappus filifolius var. *cinereus* is a relatively widespread, variable taxon the races of which occur on several soil types at various eleva-

tions: White Sands National Monument (gypsum); Espanola, New Mexico (deep sand); Cimarron, Colorado (gravelly-clay); Boulder, Colorado (black shale), etc.

The name *Hymenopappus ochroleucus* Greene is based on a white-flowered race of var. *cinereus* (as treated in this paper) which shows evidence of apparent introgression or gene-flow from var. *megacephalus*, a variety found only a short distance to the west from this locality (Cimarron, Colo.). A white-flowered race is also known in var. *lugens* of the *filifolius* complex, but that is a tetraploid, differing in several characters from the present race, which is diploid.

In the mountainous regions of northern New Mexico, var. *cinereus* appears to have two distinct altitudinal races: a leafy-stemmed ecotype at lower elevations occurring principally in deep sand (Heller 3542; Preece & Turner 2739, 2741), and a scapose ecotype at somewhat higher elevations occurring in rocky or shallow, sandy-clay soils (Heller 3555). No sharp breaks or lines can be drawn between these populations and attempts to recognize these groups on herbarium sheets has not met with success. At present it seems best to consider them only local races of a highly variable taxon.

Specimens from the rather isolated panhandle region of Texas can be distinguished from the mass of the material of var. *cinereus* by several characters, such as its more subscapose habit, longer filiform leaf segments, and apparently white flowers. It seems best, in view of our present knowledge, to consider these Texas plants no more than relict races of a once more widespread *cinereus* complex, noting, however, that further study may justify the elevation of these races to varietal rank.

Hymenopappus filifolius var. *cinereus* grades into var. *luteus* in Moffat Co., Colorado, into var. *megacephalus* in the western part of its range (E. H. Graham 8321), and into var. *lugens* and var. *pauciflorus* in the southwestern part of its range (northeastern Arizona and southeastern Utah). Locally in Colorado it intergrades with var. *parvulus* (see discussion under that variety).

Hymenopappus arenosus Heller is the earliest name for this taxon; however, Johnston, in making the varietal combination,

chose Rydberg's species (he gave no reason) and consequently *cinereus* is now the earliest varietal name and must be used, according to the International Code of Botanical Nomenclature (1952).

REPRESENTATIVE SPECIMENS.—**Arizona.** APACHE CO.: Luka-Chukai Mts., S. of View Point, *Goodman & Payson* 2831 (GH, MO, NY, UC). COCONINO CO.: between Winslow and Flagstaff, *McKelvey* 4505 (GH, POM). NAVAJO CO.: Mishongnovi, Hopi Ind. Res., *R. A. Darrow* (CAS, NY). **Colorado.** ALAMOSA CO.: Alamosa, *F. Ramaley* 12006 (RM). ARCHULETA CO.: Arboles, *C. F. Baker* 688 (GH, MO, NY, POM, RM). BOULDER CO.: 7 mi. N. of Boulder, *Preece & Turner* 2848 (SMU, WS). CHAFFEE CO.: 4 mi. W. of Salida, *Preece & Turner* 2830 (SMU, WS). DELTA CO.: Eckert, *Osterhout* 6124 (RM). DENVER CO.: Inspiration Point, *Clokey* 3951 (CAS, GH, MO, NY, POM, RM, UC, US, WS). DOUGLAS CO.: Gann, June 23, 1920, *Osterhout & Clokey* 3952 (CAS, GH, MO, POM, RM, UC, US, WS). EAGLE CO.: Deep Creek, *Killip* 36451 (US). ELBERT CO.: 2 mi. N. E. of Fondis, *M. Ownbey* 1282 (GH, MO, NY, RM, UC, WS). EL PASO CO.: Colorado Springs, June 25, 1879, *M. E. Jones s.n.* (809) (DS, NY, POM, RM, US). FREMONT CO.: Penrose, *A. Nelson* 10544 (GH, MO, NY, RM, UC). GARFIELD CO.: Rifle, *Osterhout* 2128 (NY, RM). GRAND CO.: 6.5 mi. E. of Kremmling, *Turner* 2948 (WS). HUERFANO CO.: La Veta, *Osterhout* 6700 (MO, POM, RM). JEFFERSON CO.: Morrison, *Osterhout & Clokey* 3096 (CAS, GH, RM, UC, US). LAKE CO.: Twin Lakes, 1896, *F. Clements* 386 (NY). LA PLATA CO.: Durango, *Baker, Earle & Tracy* 1028 (GH, MO, NY, POM, UC, US). LARIMER CO.: W. of Loveland, *Osterhout* 256 (NY, RM). LAS ANIMAS CO.: Brantly Canyon, *Osterhout* 2044 (GH, RM). MESA CO.: Grand Junction, *Osterhout* 6552 (POM, RM). This group of specimens presents good evidence that *H. filifolius* var. *megacephalus* hybridizes or introgresses into var. *cinereus* in this region; near coal mines, Grand Junction, June 15, 1900 (1901) *S. G. Stokes* (NY, UC, US). MONTEZUMA CO.: Mancos, *Crandall* 3205 (NY, RM). MONTROSE CO.: Cimarron, *C. F. Baker* 269 (DS, GH, MO, NY, POM, RM, UC, US, WS). OTERO CO.: Rocky Ford, July, 1894, *G. E. Osterhout* (RM). OURAY CO.: Dallas, *Preece & Turner* 2788 (SMU, WS). PARK CO.: 2 mi. W. of Glentivar, *Beetle* 224 (NY, RM). PUEBLO CO.: Walsenburg, *Rydberg & Vreeland* 5479 (NY, RM). SAGUACHE CO.: Crestone, *F. Ramaley* 12083 (RM). **New Mexico.** BERNALILLO CO.: 2 mi. E. of Albuquerque, *Krammerer* 44 (MO, NY, US). COLFAX CO.: between Cimarron and Raton, *McKelvey* 2430 (GH, POM). DONA ANA CO.: White Sands, *Wooton* 167 (DS, MO, NY, POM, RM, UC, US). HARDING CO.: about 20 mi. N. of Mosquero, *Eggleston* 20177 (NY, US). MCKINLEY CO.: Gallup, *Eastwood* 5617 (CAS). OTERO CO.: Round Mt., along Tularosa Cr., *Wooton* (US). RIO ARriba CO.: near Lybrooks, *Mathias* 617 (MO). SANDOVAL CO.: 2 mi. N. of Jemez Springs, *Preece & Turner* 2746 (SMU, WS). SAN JUAN CO.: near Huerfano Peak, *M. E. Mathias* 630 (MO). SAN MIGUEL CO.: near Pecos, *Standley* 5059 (MO). SANTA FE CO.: hills at Santa Fe, 7300 ft., *A. A. & E. G. Heller* 3555 (DS, GH, MO, NY,

POM, US, WS). UNION CO.: Emery Gap, N. M. to Branson, Colo., *Eggleston* 20154 (NY, US). VALENCIA CO.: 7 mi. N. of Trechado, *Cutler* 2092 (CAS, GH, MO, UC). **Texas.** ARMSTRONG CO.: 3 mi. S. W. of Palodura, *Cory* 13477 (GH). BRISCOE CO.: chalk hill, edge of caprock about 5 mi. W. of Quitaque, highway 85, *E. Whitehouse* 10021 (SMU). HANSFORD CO.: 5 mi. S. E. of Gruver, *Shinners* 8232 (GH, RM, SMU, UC, WS). HEMPHILL CO.: 5 mi. S. of Canadian, *Shinners* 8290 (SMU). OCHILTREE CO.: 8 mi. S. S. E. of Perryton on steep rocky bluffs only, *Shinners* 8264 (SMU). POTTER CO.: Amarillo Cr., *Reverchon* 3326 (MO, SMU). RANDALL CO.: Palo Duro Canyon, Sept. 2, 1907 *C. R. Bell* 1229 (US). **Utah.** EMERY CO.: Calf Springs Canyon, 8 mi. from road, San Rafael Swell, *B. & R. M. Maguire* 18313 (GH, NY, US, WS). GRAND CO.: Grand River Canyon, below Moab, *Rydb. & Garrett* 8495 (NY, RM). SAN JUAN CO.: between Blanding and Kigalia Ranger Station, *Holmgren & Hansen* 3484 (GH, NY, UC, US). WAYNE CO.: Thurber, *M. E. Jones* 5709C (POM, US).

4. *Hymenopappus mexicanus* Gray

Hymenopappus mexicanus Gray, Proc. Am. Acad. **19**: 29. 1883. *Rothia mexicana* O. Ktze. Rev. Gen. **1**: 361. 1891. Type examined (GH): Mexico. San Luis Potosi. "In montibus frigid[is] prope San Miguel," Sept. 1876, *Dr. J. G. Schaffner* 348.

Hymenopappus integer Greene, Pittonia **3**: 249. 1897. Isotypes examined: Mogollon Mts., (dry hills), Sept., 1881, *H. H. Rusby* 179 (180).

Hymenopappus obtusifolius Heller, Bull. Torr. Bot. Club **26**: 551. 1899. Type examined (NY): Arizona. Coconino Co.: "vicinity of Flagstaff," 7000 ft., July 5, 1898, *Dr. D. T. MacDougal* 240. A more specific locality was given in the original description by Heller as "Fort Valley, west of San Francisco mountains."

Hymenopappus petaloideus Rydb. N. Amer. Fl. **34**: 54. 1914. Type examined (NY): Arizona. Cochise Co.: "Head of Rock Creek Canyon," Chiricahua Mts., 8000 ft., Oct. 6, 1907, *J. C. Blumer* 2215.

Plants perennial, 20-90 cm. high, stems slender, erect, unbranched, greenish-glabrate to densely white-tomentose; leaves alternate, forming a basal rosette, absent or becoming reduced up the stem, simple to once-pinnate, up to 20 cm. long and 2.5 cm. wide, nearly glabrous to densely tomentose, obscurely impressed-punctate, lobes (when present) broad, ovate to broadly lance linear, 1-7 mm. wide; heads several to numerous, discoid, 20-40-flowered, in flattish cymose panicles, on slender or short-thickened peduncles 0.5-10 cm. long; involucre campanulate, principal bracts 9 to 11, nearly glabrate to densely tomentose, 7-9 mm. long, yellowish to white-membranous for 1-5 mm. from the acute to obtuse tip (rarely reddish-tinged); corollas yellow, 3-4.5 mm. long, the tube densely glandular, 2-2.5 mm. long, the throat campanulate, 1-2.5 mm. long, 3-4 times as long as the lobes; achenes obpyramidal, 4-sided, 4-6 mm. long, glabrous to sparsely puberulent (especially when immature), achene faces 2-3-nerved, rarely somewhat rugose; pappus of 12 to 20

short, obtuse to spatulate-laciniate scales, 0.4 mm. long to nearly obsolete; anthers partially exserted (rarely completely so) about 2.3 mm. long; $n = 17$.

DISTRIBUTION.—Open areas in igneous soils of yellow pine, spruce and aspen woods, central and southeastern Arizona, southwestern New Mexico, and south into the Sierra Madre Mts., states of Chihuahua, and San Luis Potosí, Mexico (Fig. 25). Late June–October.

Hymenopappus mexicanus is a very distinct species throughout its range, but it shows a great deal of variability, especially in leaf shape. *H. integer* Greene is based on a series of specimens with mostly entire leaves; however, in the field, as well as on a wide selection of herbarium material, there is no constancy in this character, populations as well as individual specimens having leaves that range from completely simple to once-pinnate.

Hymenopappus petaloideus Rydberg is a form of the species from the Chiricahua Mts., Arizona, which has more conspicuous, acute, membranous-tipped involucre bracts. This character is not peculiar to this region but occurs repeatedly throughout most of the range of the species, being quite variable even within the same general area (e.g., Mogollon Mts., New Mexico). However, material from or near the type locality of *H. mexicanus* (San Luis Potosí, Mexico) does tend to have consistently broader, more obtuse involucre bracts, this seemingly correlated with a more glandular corolla. The scarcity of material from central Mexico makes it difficult to weigh the constancy or variability of these characters in this region.

Hymenopappus mexicanus, in so far as is known, does not hybridize or intergrade with other species of the genus although one such member (*H. filifolius* var. *lugens*) was observed growing close to this species in parts of Coconino Co., Arizona. Both *H. filifolius* var. *lugens* and *H. mexicanus* occur in pine woods, but the latter species tends to occur at somewhat higher elevations, rarely, if ever, extending downslope to the juniper zone.

Hymenopappus mexicanus apparently represents a reduced line that has evolved more or less separately from the main mass of the aboriginal stock that has produced the genus as it exists today. In leaf aspect it resembles *H. artemisiaefolius* and *H. scabiosaeus*; however, in its perennial habit and floral characters it approaches *H. radiatus* (disregarding the rays). In total characters *H. mexicanus* is closer to this latter species,

but this does not mean that its ancestry can be traced through it.

REPRESENTATIVE SPECIMENS.—**Arizona.** APACHE CO.: White Mts., Black R., Thompson's Ranch, *Goodding 598* (CAS, GH, NY, RM, US). COCHISE CO.: Chiricahua Mts., head of Rock Cr. Canyon, *Blumer 2215* (GH, NY, UC). COCONINO CO.: Flagstaff, *M. E. Jones 3955* (CAS, DS, GH, NY, POM, RM, UC, US). GILA CO.: Natanes plateau, *Goodding 1094* (NY, US). NAVAJO CO.: Lakeside, *G. J. Harrison 5481* (US). PIMA CO.: Rincon Mts., *Neally 88* (NY, US). YAVAPAI CO.: Copper Basin, *Toumey 713* (US). **New Mexico.** CATRON CO.: Mogollon Mts., on Mogollon Cr., *Metcalf, 316* (DS, GH, MO, NY, POM, RM, UC, US). GRANT CO.: vicinity of Silver City, G. O. S. Ranch, *M. E. Jones 28612* (DS, MO, UC). SIERRA CO.: Mimbres Mts., top of Hillsboro Peak, *Diehl 432* (POM).

MEXICO. **Chihuahua.** Near Colonia Garcia, *Townsend & Barber 137* (GH, MO, NY, POM, RM, UC, US). **San Luis Potosí.** Pelote, *Purpus 4722* (MO, UC); Minas de San Rafael, *Purpus 4772a* (GH, NY, UC).

SERIES BIENNES

5. *Hymenopappus biennis* sp. nov.

Herbae biennes e radicibus simplicibus obconicis; caulibus foliatis ramosis erectis solitariis; foliis inferioribus sparse tomentosis bipinnatis 6–16 cm. longis, segmentis remotis anguste linearibus 6–20 mm. longis, 1–3 mm. latis; inflorescentiis laxe cymoso-paniculatis 20–60 capitulatis; capitulis radiatis, radiorum floribus 1-seriatis pistillis fertilibus, discorum hermaphroditis; involueris campanulatis, bracteis 5–8 mm. longis, 3–5 mm. latis, 2–3-seriatis; radiorum corollis ligulatis albidis 14–16 mm. longis, 6–8 mm. latis, disci flavis 3–3.5 mm. longis, tubo 1.5 mm. longo, fauce campanulata, lobis aequalibus triangularibus; achaeniis glabris quadrangularibus 4 mm. longis; pappo obscuro.

Plants biennial, 60–100 cm. tall; stems single from each tap-root, much-branched and leafy, tomentose to nearly glabrate, pithy at the center or often hollow; basal rosette leaves 6–16 cm. long, 3–6 cm. wide, bipinnately dissected into linear, mostly flattened, ultimate segments 6–20 mm. long, 1–3 mm. wide, sparsely tomentose to nearly glabrate, conspicuously impressed-punctate; stem leaves 10–40, gradually reduced upward; heads 20–40 per stem, campanulate, 40–60-flowered, on ultimate peduncles 1–6 cm. long, inflorescence a large, much-branched, cymose panicle; receptacle dome-shaped, without chaff; principal involucrel bracts 5–8 mm. long, 3–5 mm. wide, sparsely tomentose to nearly glabrate, yellow-membranous for 1–2 mm. from the acute to obtuse tip; ray flowers 8, pistillate and fertile, tubular at the base for about 2 mm., extending into a conspicuous white ligule 14–16 mm. long, 6–8 mm. wide, not cleft at the apex or obscurely so; disk flowers yellow, 3–3.5 mm. long, the tube densely glandular 1.5 mm. long, the throat campanulate 1.5–2 mm. long with lobes reflexed, 2–3 times longer than the acute lobes; achenes black, glabrous (or with a few sessile glands near the apex),

4 mm. long, obpyramidal, 4-sided, becoming incurved near the periphery of the head; pappus obsolete or nearly so (0–0.2 mm. long); anthers partially exserted, 2.5 mm. long; chromosome number not known. TYPE consisting of 2 sheets (GH): Texas. Culberson Co.: Guadalupe Mts., "wooded rocky ridge above McKittrick Canyon, 2300 m.," July 17, 1931, *J. A. Moore & J. A. Steyermark 3484* (Isotypes CAS, DS, MO, NY, UC).

DISTRIBUTION.—Principally in limestone soils in pine woods and protected canyons of central and south-central New Mexico (Sandia, Oscuro, and Sacramento Mts.), extending into the Guadalupe Mts. of Trans-Pecos Texas, 7,000–10,000 ft. (Fig. 24). July–October.

Hymenopappus biennis is a distinct species the total morphological relationships of which are undoubtedly with *H. newberryi* and *H. radiatus*. It differs from both these species, however, in several fundamental characters. *Hymenopappus biennis* is a tall, leafy biennial, whereas *H. newberryi* and *H. radiatus* are smaller, subscapose perennials. Since all three of these radiate taxa are perfectly distinct, being separated by morphological and geographical discontinuities which, insofar as is known, are not bridged, they are treated here as species.

The discovery of *H. biennis* has made possible a better understanding of the evolutionary trends which seem to have taken place within the genus *Hymenopappus*. It appears to be the "missing link" which ties a part of the biennial complex back to the perennial groups. Indeed, with rays, *H. flavomarginatus* would be a near perfect match for *H. biennis*. It is likely that *H. biennis* is an early off-shoot of the line that gave rise to the perennial radiate species. Thus, one might assume that the major evolutionary lines within the genus were established at a relatively early time, each of these lines retaining certain primitive characters of the supposed common progenitor. In the subsequent development, each of these lines seems to have gained new characters while modifying or losing old ones.

REPRESENTATIVE SPECIMENS.—**New Mexico.** LINCOLN CO.: Ruidoso, *Fisher 65* (CAS, US); Mescalero Ind. Reservation, June 23, 1895, *Wooton* (US); White Mts., *Wooton 264* (DS, MO, NY, POM, RM, UC, US); White Mts., 5 mi. above Agency, *Wooton & P. Standley 3552* (US). OTERO CO.: Sacramento Mountains: Clouderoft, *Cockerell 35* (RM), *E. D. Shulz 252* (US), Aug. 1914, *H. D. Slater* (US), Aug. 8, 1899, *Wooton* (POM), Aug. 15, 1899, *Wooton* (US), Aug. 1, 1916, *M. S. Young* (UC); Rolland Canyon, Clouderoft, *Eggleston 14500* (US); Sacramento Mountains: James Canyon, July 23, 1899, *Wooton* (NY), July 6, 1899, *Wooton* (DS,

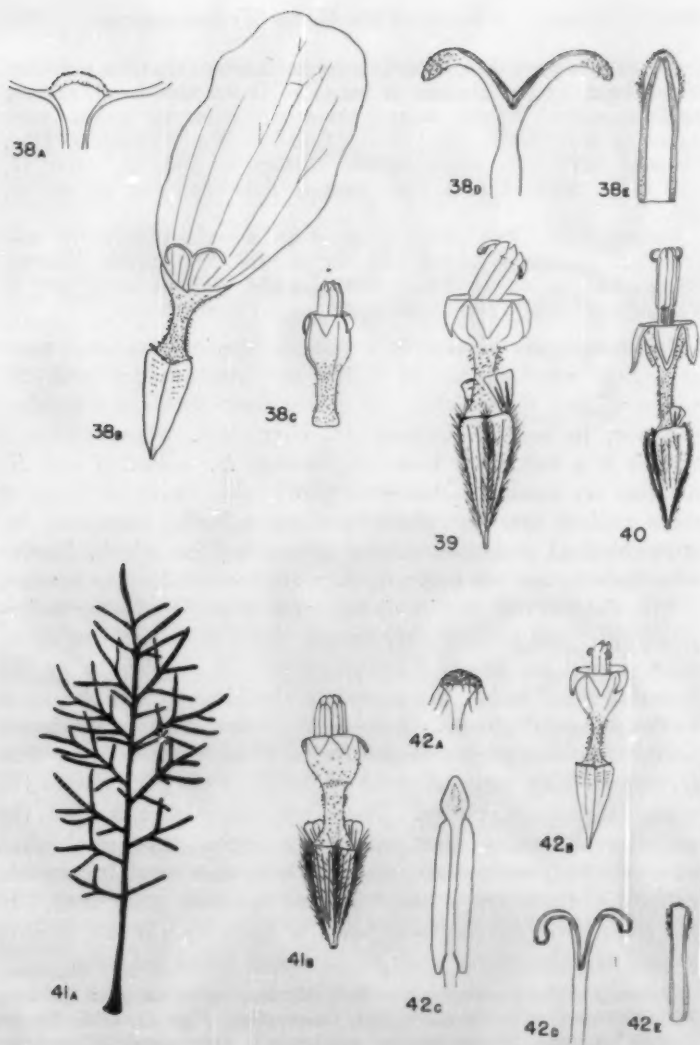


FIG. 38-42. Morphology of *Hymenopappus* species, Series Biennes. Fig. 38. *H. biennis* (Isotype); (a) receptacle, long. sec., $\times 4$; (b) radial floret, $\times 8$; (c) disk corolla, $\times 8$; (d) style branches, \times ca. 45; (e) upper surface of style branch, \times ca. 45. Fig. 39. *H. flavescens* var. *canotomentosus* (Type), floret, part of pappus removed, $\times 8$. Fig. 40. *H. artemisiaefolius* var. *artemisiaefolius* (Lindheimer 107, Fasc. II), floret, part of pappus removed, $\times 8$. Fig. 41. *H. tenuifolius* (T. 2895); (a) silhouette of basal leaf $\times \frac{1}{2}$; (b) floret, part of pappus removed, $\times 8$. Fig. 42. *H. flavomarginatus* (Type); (a) receptacle, $\times 4$; (b) floret $\times 8$; (c) anther, \times ca. 40; (d) style branches, \times ca. 40; (e) upper surface of style branch, \times ca. 40.

UC, US); White Mts., above Mescalero, Aug. 4, 1901, *Wooton* (US); Tularosa Cr., 3 mi. S. of Mescalero Agency, *C. B. Wolf* 2762 (CAS, DS, GH, RSA). SANDOVAL CO.: Sandia Mts., near Oshan Springs, Aug.-Sept., *C. E. Ellis* 345 (MO). SIERRA CO.: Lookout Mines, south end of Black Range, *Metcalf* 1176 (CAS, MO, US). SOCORRO CO.: Oscuro Mts., July 21, 1898, *F. S. Earle* (MO, NY). **Texas.** CULBERSON CO.: Guadalupe Mts., in "The Bowl," summit of Pine Top Mt., *Correll* 13920 (SMU); Guadalupe Mts., Oct., 1881, *V. Havard* (US); S. McKittrick Canyon, Guadalupe Mts., *Hinckley* 4472 (US); ridge above McKittrick Canyon, July 17, 1931, *Moore & Steyermark* 3484 (CAS, DS, GH, MO, NY, UC); Guadalupe Mts., S. McKittrick Canyon, *Muller* 8287 (SMU, WS).

6. *Hymenopappus flavomarginatus* Johnston

Hymenopappus flavomarginatus Johnston, Contrib. Gray Herb. n.s. 68: 95. 1923. Type examined (GH): Mexico. Coahuila. "Can[y]on and elevated portion of Sierra Madre, 12 to 14 leagues south of Saltillo, Mexico; July 25 to August 1st—1880" (data from isotype label, US), *E. J. Palmer* 650.

Plants biennial, 30–100 cm. high, sparsely canescent to glabrate; larger rosette leaves 6–12 cm. long, bipinnately dissected with linear ultimate divisions mostly 5–20 mm. long, 1–2 mm. wide, the petioles often reddish at base, comprising less than $\frac{1}{2}$ the leaf length; stem leaves 10–20, becoming reduced up the stem; heads per stem 10–30, campanulate, 30–100-flowered, on ultimate peduncles 3–11 cm. long, these with conspicuous membranous basal bracts, 4–9 cm. long, 3–7 mm. wide; inflorescence an open cymose panicle; principal involucre bracts broadly obovate to oval, 6–9 mm. long, 4–8 mm. wide, yellow-membranous (often red-tinged) for 1–3 mm. from the broadly obtuse tip; corollas "yellow," 2.7–3.5 mm. long, the tube 1.5–2 mm. long, densely glandular-pubescent to nearly glabrate, the throat campanulate, 1.2–1.5 mm. long with lobes reflexed, 1–2 times longer than the lobes; achenes obpyramidal, 4-sided essentially glabrous, 3–4 mm. long; pappus of 18–22 minute scales (0.1–0.2 mm. long) or obsolete; anthers not completely exerted, about 2 mm. long; chromosome number not known.

DISTRIBUTION.—Known only from pine and oak woodlands in the mountains of north-central Mexico, states of Coahuila, Nuevo León, and San Luis Potosí, 7500–9000 ft. (Fig. 25). May–August.

This is a well marked species, undoubtedly belonging close to the *H. flavescens* and *H. tenuifolius* groups as suggested by Johnston in his original description. Its closest relationship seems to be with *H. biennis*, however, for in total characters it resembles this species of *Hymenopappus* more than any other member of the genus, differing principally in the lack of rays and in the broader involucre bracts. It also has some characters of *H. artemisiaefolius* such as the large, membranous peduncular bracts of that species. In short, the species has characters

which connect it to nearly all of the more primitive members of the genus, suggesting that it is of an old age and has developed along its own line, retaining some characters and losing others.

REPRESENTATIVE SPECIMENS.—MEXICO. **Coahuila.** 24 kilometers N. W. of Fraile, 2900 meters, July 15, 1941, *Stanford, Retherford & Northcraft 421* (DS, MO, NY, UC). **Nuevo León.** Municipio de Galeana, Hacienda Cieneguillas on Cerro Potosí, 8000 ft., Aug. 7, 1938, (students of) *Mexican Biological Expedition, University of Illinois* (GH, MO, NY). **San Luis Potosí.** Charcas, Santo Domingo Road, July–Aug., 1934, *Lundell 5604* (DS, GH, MO, US).

7. *Hymenopappus tenuifolius* Pursh

Hymenopappus tenuifolius Pursh, Fl. Am. Sept. 2: 742. 1814. *Rothia tenuifolius* O. Ktze. Rev. Gen. 1: 361. 1891. Type collected "in upper Louisiana" by Bradbury; no specimen could be found in the American herbaria consulted. It was probably collected in what is now South Dakota. The description, combined with the statement that "the flowers are white," leaves little doubt as to its identity.

Hymenopappus corymbosus var. *nuttallii* T. & G. Fl. N. Am. 2: 372. 1842. Type or isotype examined (GH): "Red River, Arkansas," without additional information, but probably collected by Nuttall in what is now southern Oklahoma.

Hymenopappus tenuifolius Nutt. non Pursh, in T. & G. Fl. N. Am. 2: 372. 1842, as synonym of above.

Plants biennial, 40–150 cm. high; stems from a single tap-root (rarely 2 crowns forming on a root, especially on injured plants), erect, much-branched, angled and grooved, sparsely white-tomentose to more frequently nearly glabrous; leaves alternate, forming the first year a basal rosette, the larger basal leaves 8–15 cm. long, 4–5 cm. wide, bipinnately dissected with linear, filiform, ultimate segments 0.5–1.5 mm. wide, conspicuously impressed-punctate, the stem leaves 8–30, becoming reduced upwards; heads numerous (20–200), discoid, 25–50-flowered, on pubescent to glabrate ultimate peduncles 1–5 cm. long; inflorescence a flat-topped cymose panicle; involucre campanulate, the principal bracts mostly glabrate (rarely tomentose) or densely glandular, 5–8 mm. long, 2–4 mm. wide, yellowish-membranous for 1–2 mm. from the acute to obtuse tip; corollas white, 2.5–3 mm. long, the tube glandular, 1.5–2.2 mm. long, the throat campanulate, 0.8–1.5 mm. long with lobes reflexed, 1.5–2 times longer than the lobes; achenes 3.5–4.5 mm. long, 4-sided, the faces 2–3-nerved, pubescent principally on the corners with hairs 0.5–1 mm. long; pappus of 16–18 linear oblong scales, 1–1.5(–2) mm. long; anthers mostly completely exserted, 2–2.5 mm. long; $n = 17$.

DISTRIBUTION.—Common on the southern Great Plains of the central United States from South Dakota to south-central Texas in sandy or, less frequently, gravelly or rocky limestone soils; also in New Mexico on intermontane plains (Fig. 43). Late May–August.

Hymenopappus tenuifolius overlaps several related taxa in its range, but evidence of present-day hybridization and possible introgression is found in relatively few localities. One such area is in the Panhandle of Texas where small, less leafy, woolly-stemmed individuals are occasionally found, suggesting possible contamination of the species from disjunct, perennial, white-flowered races of *H. filifolius* var. *cinereus*, a taxon the normal range of which is in the Rocky Mountains (Fig. 37). This is of interest since it has been suggested that the perennial, yellow-flowered tetraploid, *H. filifolius* var. *polycephalus* (a member of the northern Great Plains flora) is possibly the

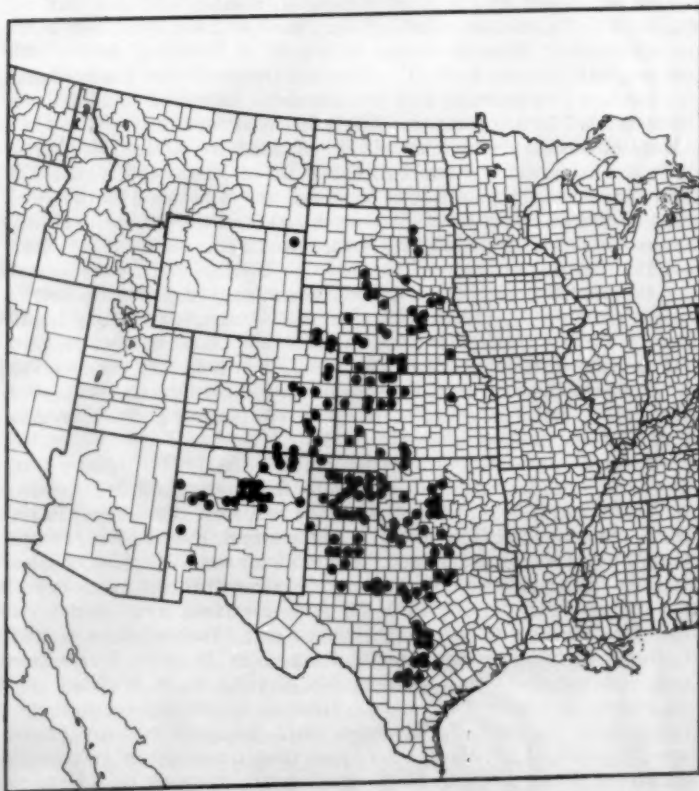


FIG. 43. Distribution of *Hymenopappus tenuifolius*.

result of amphiploidy between *H. tenuifolius* and *H. f. cinereus* (see discussion under *H. f. polycephalus*). Natural hybridization of these two taxa in the Panhandle of Texas would seem to add support to such an hypothesis.

The isolation of *H. tenuifolius* from the adjacent, more easterly taxon, *H. scabiosaeus* var. *corymbosus*, where the two species overlap, is perhaps partly seasonal, the latter entity having its principal flowering time 3-4 weeks before *H. tenuifolius*.

REPRESENTATIVE SPECIMENS.—Colorado. BACA CO.: Springfield, *Osterhout 5054* (RM). BENT CO.: Las Animas, *Osterhout 3915* (RM). CHEYENNE CO.: Plains near Cheyenne Wells, July 12, 1887, *C. H. Demetrio* (GH). ELBERT CO.: about 25 mi. E. of Kiowa, *M. Ownbey 1293* (GH, MO, NY, RM, UC, WS). KIOWA CO.: Eads, *Baker, Earle & Tracy 1029* (MO, POM). LAS ANIMAS CO.: Mesa de Maya, 60 mi. E. of Trinidad, *Rollins 1838* (GH, MO, NY). LINCOLN CO.: E. of Limon, *Osterhout 8226* (RM). OTERO CO.: Apishpa Cr., *Osterhout 2043* (GH, NY, RM). SEDGWICK CO.: Julesburg, *Osterhout 4907* (RM). YUMA CO.: Wray, *Osterhout 3983* (RM).

Kansas. BARBER CO.: 5 mi. S. W. of Medicine Lodge, *Rydberg & Imler 684* (MO, NY). CLARK CO.: 6 mi. W. of Englewood, *Rydberg & Imler 834* (NY). DECATUR CO.: Jennings (no additional data) (MO). ELLIS CO.: 12 mi. N. of Hays, *E. Runyon 130* (CAS, GH, MO, RM). FINNEY CO.: near Garden City, *Coville 27* (US). GROVE CO.: plains, *A. S. Hitchcock 287* (GH, MO, NY, RM, US). GRANT CO.: Ulysses, *C. H. Thompson 24* (MO, US). NORTON CO.: Almenz, *Harshbarger* (US). OSBORNE CO.: within 5 mi. of Osborne City, *Shear 71* (GH, NY, RM). PHILLIPS CO.: Long Island, June 15, 1885, *J. B. Hatcher* (UC). RAWLINS CO.: Atwood, May 30, 1891, *L. Fry* (NY). RILEY CO.: Manhattan, 1892, (w/o collector) (NY). ROOKS CO.: Rockport, June 10, 1891, *E. Bartholomew* (UC). TREGO CO.: Wakeeney, July 8, 1892, *M. Reed & A. D. H.* (NY). WALLACE CO.: Wallace, Aug. 22, 1884, *Letterman* (MO, NY, US).

Nebraska. ANTELOPE CO.: Neligh, June 3, 1906, *E. S. Bacon* (GH). BOONE CO.: 4 mi. W., 1.5 mi. N. of Lorette, *B. Osborn 1216R* (MO). BROWN CO.: Lone Pine, July 13, 1899, *J. M. Bates* (GH, RM). CEDAR CO.: Beaver Cr., *F. Clements 2664* (NY, UC, US). CHASE CO.: S. E. of Enders, Frenchman Valley, *Tolstead 41427* (MO). CHERRY CO.: near Valentine, *Tolstead 339* (GH). CHEYENNE CO.: N. of Sidney, *Osterhout 7196* (MO, RM). CUSTER CO.: Broken Bow, July 4, 1889, *H. J. Webber* (MO, NY). DEUEL CO.: Rush Cr., *Rydberg 194* (NY). FRANKLIN CO.: Franklin, July 4, 1930, *H. Hapeman* (WS). GRANT CO.: Whitman, June 20, 1938, *E. Anderson* (MO). GREELY CO.: Greely Center, July 4, 1889, *T. A. Williams* (US). HITCHCOCK CO.: near Culbertson, *Tolstead 411426* (MO). HOLT CO.: Ewing, June 19, 1899, *J. M. Bates* (GH). KEARNEY CO.: dry prairie, June 28, 1894, *J. E. Bodin* (NY, POM, RM). LANCASTER CO.: prairie formations, Sept., 1898, *G. G. Hedgcock* (MO). LINCOLN CO.: Hershey, *C. D. Mill 73* (NY, US). PHELPS CO.: sand hills, *Rydberg 194* (NY, US).

New Mexico. BERNALILLO CO.: Sandia Mts., Tijiras Canyon, *C. C. Ellis* 459 (MO, NY, US). CATRON CO.: Patterson, Aug. 15, 1900, *E. O. Wooton* (US). COLFAX CO.: Cimarron Canyon, *Mathias* 554 (MO, POM). GRANT CO.: near San Lorenzo, July 26, 1906, *E. Wooton* (US). GUADALUPE CO.: Anton Chico to Santa Rosa, *Arsène & Benedict* 16686 (CAS). MCKINLEY CO.: Gallup, *Degener* 4831 (NY). QUAY CO.: Logan, May 31, 1911, *E. Wooton* (US). SAN MIGUEL CO.: vicinity of Las Vegas, Romero-ville, *Arsène & Benedict* 15480 (US). SANTA FE CO.: 14 mi. S. of Santa Fe, July 7, 1951, *Turner* 2895 (SMU, WS). UNION CO.: Emery Gap to Branson, Colorado, *Eggleston* 20156 (GH, NY). VALENCIA CO.: Alamositas Canyon, July 15, 1906, *Wooton* (US).

Oklahoma. CADDO CO.: Cement, *Demaree* 12540 (MO, NY). CARTER CO.: 4 mi. N. E. of Ardmore, *G. E. Hall* 123 (RM). CIMARRON CO.: 11 mi. N. of Boise City, *R. Stratton* 454 (MO). CLEVELAND CO.: 4 mi. W. of Norman, *Demaree* 12772 (MO, NY). COMANCHE CO.: Wichita Nat'l. Forest, June 12, 1926, *A. J. Ortenburger* (US). CUSTER CO.: 1 mi. W. & 1 mi. S. of Weatherford, *Waterfall* 5513 (GH). ELLIS CO.: Canadian R. valley, near Pack Saddle Bridge, *Goodman* 2598 (GH, MO, NY, RM). JACKSON CO.: near Snyder, *G. W. Stevens* 1275 (GH, NY). LOGAN CO.: near Guthrie, *G. W. Stevens* 3324 (NY). MCCLAIN CO.: Johnson's Pasture, *Eskew & Barkley* 1202 (MO). OKLAHOMA CO.: 5 mi. E. & 4.5 mi. N. of Oklahoma City, *Waterfall* 1311 (NY). PAYNE CO.: 14 mi. S. W. of Stillwater, *Stratton* 3753 (CAS). ROGER MILLS CO.: Roger, Antelope Hills, *Ortenburger* 114 (US). STEPHENS CO.: S. of Comanche, *Waterfall* 3680 (NY). WOODS CO.: July 6, 1900, *P. J. White* (RM).

South Dakota. BEADLE CO.: Huron, July 11, 1896, *T. A. Williams* (MO). CHARLES MIX CO.: Colvin, Aug. 29, 1892, *E. T. & S. A. Harper* (US). MELLETT CO.: Valley of White R., May 1855, *F. V. Hayden* (NY). SPINK CO.: Northville, *J. F. Brenckle* 41-69 (CAS, GH, MO, NY, SMU). TODD CO.: Highland, Antelope Cr., *E. J. Wallace* 22 (NY).

Texas. ANTASCOSA CO.: 12 mi. N. of Pleasanton, *Cory* 19178 (GH). ARMSTRONG CO.: Gamble's Ranch, *E. J. Palmer* 13912 (MO). BEXAR CO.: 15 mi. S. of San Antonio, *Schulz* 421 (US). BOSQUE CO.: 12 mi. N. N. E. of Walnut Springs, *Shinners* 10067 (SMU). CALLAHAN CO.: Baird, Aug., 1882, *Letterman* (GH, MO). COMAL CO.: New Braunfels, *Dapprich* 6207 (SMU). COMANCHE CO.: Round Top Mt., May 9, 1900, *H. Eggert* (MO). COOKE CO.: Tyler Bluff, western edge of county, *D. S. & H. S. Correll* 12996 (SMU). CROSBY CO.: 3 mi. E. of Crosbyton, *Shinners* 8362 (SMU). DALLAS CO.: Dallas, May, 1876, *J. Reverchon* (MO, NY). DAWSON CO.: between Lamesa and Tahoka, *Small & Wherry* 12130 (NY). DICKENS CO.: 1.5 mi. E. of Dickens, *Shinners* 8379 (SMU). DOWLEY CO.: 7 mi. N. W. of Memphis, *Innes & Moon* 1013 (GH). GARZA CO.: Post, *E. J. Palmer* 13856 (MO, US). GONZALES CO.: Waelder, July 9, 1889, *M. Hopkins* (US). HANSFORD CO.: 5 mi. S. E. of Gruver, *L. H. Shinners* 8233 (SMU). HAYS CO.: San Marcos and vicinity, Sept. 1, 1896, *S. W. Stanfield* (NY). HEMPHILL CO.: 5 mi. S. of Canadian, *Shinners* 8280 (GH, SMU, UC). HOOD CO.: prairies N. of Granbury, May 4, 1900, *H.*

Eggert (MO). HOWARD CO.: prairies N. of Big Springs, June 11, 1900, *Eggert* (MO). HUTCHINSON CO.: 2 mi. S. of Borger, *Shinners* 8092 (SMU). LAMPASAS CO.: 1 mi. S. of Lampasas, *Whitehouse* 15381 (SMU). LIPSCOMB CO.: Lipscomb, A. H. *Howell* 41 (US). LUBBOCK CO.: Posey Canyon, *Demaree* 7574 (GH, MO, WS). MEDINA CO.: 2.75 mi. S. W. of Devine, *Cory* 12814 (GH). MOTLEY CO.: 16.4 mi. E. of Matador, *Whitehouse* 9914 (SMU). NOLAN CO.: 3 mi. E. of Sweetwater, *Waterfall* 6736 (GH). OCHILTREE CO.: 8 mi. S. S. W. of Perryton, *Shinners* 8265 (SMU). OLDHAM CO.: Magenta, *Shinners* 8158 (SMU). FARMER CO.: Bovina, F. S. *Earle* 684 (NY). POTTER CO.: 5 mi. S. of Canadian R., highway 287, B. & H. *Jespersen* 2695 (DS, MO, RM, UC, SMU, WS). RANDALL CO.: 15 mi. E. of Canyon, Palo Duro State Park, *Shinners* 8023 (SMU, WS). ROBERTS CO.: 2.5 mi. S. W. of Miami, *Shinners* 8310 (SMU). SHERMAN CO.: 25 mi. E. and 4 mi. S. of Stratford, *Shinners* 8223 (SMU). TAYLOR CO.: Camp Barkeley, *Tolstead* 7024 (MO, SMU, UC). TRAVIS CO.: Glen Rose, divide between Cow and Sandy Creeks, R. T. *Hill* 9 (US). WICHITA CO.: 10.7 mi. N. of Electra, *Whitehouse* 10489 (SMU). WILBARGER CO.: 6.5 mi. N. of Oklaunion, S. side of Red R., *Whitehouse* 10961 (SMU). WILSON CO.: Kicaster School, *Cory* 15144 (GH). WISE CO.: 3 mi. W. of Decatur, *Shinners* 7934 (SMU).

Wyoming. CROOK CO.: Bear Lodge Mts., Aug., 1897, D. *Griffiths* s.n. (MO). This record should be checked since, if correct, it represents a considerable extension of range for the species.

8a. *Hymenopappus flavescens* Gray, var. *flavescens*

Hymenopappus flavescens Gray, Mem. Am. Acad. Arts. Sci. n.s. 54 (1): 97-98. 1849. *Rothia flavescens* (Gray) O. Ktze. Rev. Gen. 1: 361. 1891. Type examined (GH): New Mexico. "Between San Miguel and Las Vegas, 10 miles W. of Vegas," Aug. 14, 1847, A. *Fendler* 464. Locality cited is that on isotypic material at MO.

Hymenopappus fisheri Wooton & Standley, Contrib. U. S. Natl. Herb. 16: 191. 1913. Type examined (us): New Mexico. Quay Co.: "Collected at Nara Visa, clay and sand soil," Sept. 8, 1910, G. L. *Fisher* 16.

Plants biennial, 45-90 cm. high, the stems single from each tap-root; larger rosette leaves 6-14 cm. long, sparsely canescent to glabrate above, densely tomentose below (rarely tomentose on both surfaces). bipinnately parted (except for the first 1-4 leaves) with broad ultimate segments mostly 2-6 mm. wide; stem leaves 15-40, becoming reduced upward; heads 30-100 per stem, campanulate, 30-70-flowered, on short ultimate peduncles 0.5-3 cm. long; inflorescence a many-headed, mostly congested, cymose panicle; principal involucrel bracts pubescent to glabrate, 4-5(-6) mm. long, 2-4 mm. wide, yellow-membranous for about 1 mm. from the acute or narrowly obtuse tip; corollas bright yellow, 2.5-3.5 mm. long, the tube densely to sparsely glandular, 1.5-2 mm. long, the throat abruptly campanulate to campanulate-funnelform, 0.8-1.5 mm. long, with lobes reflexed, as long as the lobes (rarely shorter); achenes obpyramidal, 4-sided, 3.5-4 mm. long, pubescent principally on the corners with

hairs 0.3–1 mm. long; pappus of 18–20 linear-oblong scales, 0.5–1(–1.2) mm. long; anthers mostly completely exerted, about 2 mm. long; $n = 17$.

DISTRIBUTION.—Principally northwestern Texas on the Llano Estacado (Staked Plains) and its periphery; eastern New Mexico, western Oklahoma, southwestern Kansas and southern Colorado (known in this latter state by only one collection from along a roadside south of Trinidad), mostly in deep, red, sandy soils, commonly associated with "shinnery" (*Quercus* spp.) in the western part of its range (Fig. 46). Late May–September (See Fig. 44).

In the eastern part of its range (Hemphill Co., Texas) there is considerable intergradation of this variety with *Hymenopappus scabiosaeus* var. *corymbosus* with respect to corolla and leaf shape, pappus length, and general pubescence; in the western part of its range (eastern New Mexico) there is a similar but strong intergradation of these same characters with those typical of *H. flavescens* var. *cano-tomentosus*. This, combined with the ranges of the taxa involved, makes it seem probable that the variety is of hybrid nature, having had its origin at some past time, perhaps during a pluvial period, when the ranges of *H. scabiosaeus* var. *corymbosus* and *H. flavescens* var. *cano-tomentosus* had considerable overlap. With subsequent withdrawal of the putative parents at a later time, the hybrids and their derivatives were left isolated and have since evolved more or less independently. A similar situation has been hypothesized for some species of *Quercus* by Muller (1951). An alternate hypothesis would be that the variety has evolved, without this factor of hybridization, from *H. flavescens* var. *cano-tomentosus* entirely as a result of mutation and selection in its appropriate habitat and has since this initial isolation come into contact and introgressed with the two peripheral taxa mentioned. Experimental crosses between these entities should do much to offer positive evidence.

The taxon is placed as a variety within the same species as *cano-tomentosus* since it resembles this taxon phenotypically more than it does *H. scabiosaeus* var. *corymbosus*, perhaps indicating that it has drawn a larger number of characters from the latter by the hybridization and introgression visualized above.

Figure 44 has been constructed from information tabulated by the method given in the footnote, p. 241. By comparison

of the flowering dates of the taxa mentioned, it will be noticed that var. *corymbosus* begins flowering early, rapidly reaches a peak, then drops off less sharply leaving only a few late-flowering individuals which overlap into the longer, continuous flowering period of var. *cano-tomentosus*. Assuming that var. *flavescens* became partially isolated seasonally from *H. scabiosaeus* var. *corymbosus*, either as a result of hybridization or mutation, it is clear that present crossing and resulting introgression will be more with *H. flavescens* var. *cano-tomentosus* than *H. scabiosaeus* var. *corymbosus* since there would be more opportunities for crossing with the former.

Hymenopappus flavescens was reduced to synonymy under *H. corymbosus* by Johnston (1923) with the following statement, "Gray's *H. flavescens* was based upon a good specimen of the present species, *H. corymbosus* collected by Fendler, and upon a few fragments, apparently of *H. artemisiaefolius*, which were collected by Wislizenus." However, *H. flavescens* as defined by Gray may be distinguished immediately throughout its range from *corymbosus* by its later blooming period, yellow flowers, and more campanulate corolla-throat; the latter is

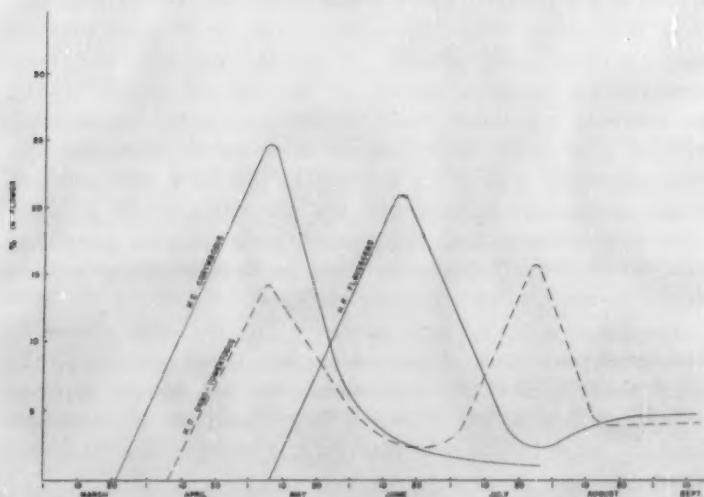


FIG. 44. Graph showing dates of flowering expressed in per cent of herbarium specimens examined from eastern New Mexico, Texas, and western Oklahoma.

white flowered and has a predominately funnellform throat. Fendler's collections (type and isotypes) are biologically typical specimens of *H. flavescens* as are Wislizenus' fragments. *H. artemisiaefolius* is a species of the pine woods in eastern Texas, and certainly was not collected by Wislizenus on the "Santa Fe Road" in New Mexico.

REPRESENTATIVE SPECIMENS.—**Colorado.** LOS ANIMAS CO.: 12 mi. S. of Trinidad, highway 87, May 29, *Brenckle 48139* (SMU). **Kansas.** GRANT CO.: Ulyesses, *Thompson 64* (MO, US). HAMILTON CO.: sandhills, *A. S. Hitchcock 607* (286) (GH, MO, NY, RM). SEWARD CO.: W. of Liberal, *McKelvey 2488* (GH, POM). STEVENS CO.: sandhills, *H. W. Norris 91* (MO). **New Mexico.** CHAVEZ CO.: 7 mi. N. E. of Boaz, *Waterfall 4321* (GH, MO, NY). DE BACA CO.: La Lande, *Pohl 5036* (SMU). EDDY CO.: near Loving, *Standley 40361* (US). LEA CO.: 5 mi. N. of Eunice, *Turner 2947* (SMU, WS). LINCOLN CO.: 35 mi. W. of Roswell, *F. S. & E. S. Earle 508* (NY). QUAY CO.: Nara Visa, *G. L. Fisher 16* (RM, US). ROOSEVELT CO.: 5 mi. N. E. of Portales, *Goodman & Hitchcock 1123* (CAS, DS, GH, MO, NY, RM, UC). SAN MIGUEL CO.: between San Miguel and Las Vegas (10 mi. W. of Vegas), *Fendler 464* (417) (GH, MO). SANTA FE CO.: near La Glorieta, *Brandege 12068* (MO, UC). UNION CO.: Willow Bar of the Cimarron, *Fendler 463* (417) (MO). **Oklahoma.** BECKHAM CO.: Sayre, *R. Stratton 338* (MO). DEWEY CO.: W. of Vici, *Goodman 2577* (CAS, GH, MO, NY, RM). WOODWARD CO.: Indian Cr. Station, 7 mi. S. E. of Woodward, *A. & R. Nelson 5651* (RM).

Texas. BAILEY CO.: 5 mi. N. W. of Muleshoe, *Correll 13107* (SMU). CASTRO CO.: Dimmitt, *E. L. Reed 3558* (US). CHILDRESS CO.: 9 mi. N. of Childress along Red R., *Whitehouse 18699* (SMU). CRANE CO.: near Crane, highway 51, *L. Cutak 3* (MO). CROSBY CO.: 30 mi. S. W. of Spur along Blanco R., *Erlanson 1196* (SMU). DALLAM CO.: 7 mi. N. W. of Dalhart, *Shinners 8176* (GH, RM, SMU, UC). DONLEY CO.: 9 mi. S. W. of Claredon, *Innes & Moon 1019* (DS, GH). FISHER CO.: 7.5 mi. E. of Roby, *Whitehouse 16724* (SMU). GAINES CO.: 15.1 mi. W. of Lamesa, highway 180, *Whitehouse 16779* (SMU). GARZA CO.: near Double Mt. R., *A. Ruth 1308* (US). HALL CO.: W. of Estelline, May 26, 1906, *Reverchon* (MO). HARDEMAN CO.: 12 mi. N. of Chillicothe, *Cory 13395* (GH). HARTLEY CO.: 10 mi. E. of Romero, *Cory 16464* (GH). HEMPHILL CO.: prairies N. of Canadian, June 7, 1901, *H. Eggert* (MO). HOWARD CO.: near Big Spring, *E. J. Palmer 34006* (MO, NY). KENT CO.: 1 mi. S. of Jayton, *Shinners 8387* (SMU). LAMB CO.: 8 mi. S. of Olton, *Cory 13550* (GH). LUBBOCK CO.: Lubbock, *Studhalter 1270* (US). MITCHELL CO.: N. of Colorado, June 9, 1900, *Eggert* (MO). POTTER CO.: 1.4 mi. S. of Canadian R. Bridge, highway 287, *B. & H. Jespersen 2686* (DS, MO, RM, SMU, UC, WS). RANDALL CO.: Palo Duro Canyon, *A. C. Martin 292* (US). RUNNELS CO.: Ballinger, *E. J. Palmer 10326* (DS, MO, US). TERRY CO.: Wellman, July 10, 1941, *B. C. Tharp* (GH, MO). WARD CO.: 3.5 mi. E. of Monohans, sand dunes, *C. H. Muller 8528* (SMU).

Sa. *Hymenopappus flavescens* var. *cano-tomentosus* Gray

Hymenopappus flavescens var. *cano-tomentosus* Gray, Pl. Wright 2: 94. 1852. Type examined (GH): "Sandhills near Frontera, New Mexico; April, May, " 1851-1852, C. Wright 1412. Quoted locality is that given in the type description.

Hymenopappus canescens var. *cano-tomentosus* Rothrock, in Wheeler Exped. 6: 167. 1878. This name is apparently an error for *Hymenopappus flavescens* var. *cano-tomentosus* Gray.

Hymenopappus robustus Greene, Bull. Torr. Bot. Club 9: 63. 1882. Probable isotype examined (GH): New Mexico. Grant Co.: "collected near Santa Rita del Cobre in 1877," E. L. Greene s.n. (22). A type was not designated by Greene, only the phrase "common on the sandy plains of New Mexico" being used to identify the collections from which the description was drawn. The specimen cited above has the annotation "forma robusta" on the collection label, apparently put there by Greene himself. There can be little doubt that the plant referred to is *H. flavescens* var. *cano-tomentosus* Gray. It is apparently common on the plains near Silver City, New Mexico, where Greene resided at the time of his publication.

Plants biennial, 30-90 cm. high, the stems typically densely tomentose, single from each tap-root (rarely 2 crowns forming on injury); larger rosette leaves 6-15 cm. long, 2-4 cm. wide, evenly pubescent on both surfaces, usually densely tomentose, but often merely canescent, bipinnately dissected with the small, narrow, ultimate segments 1-2 mm. wide; stem leaves 10-50, becoming reduced upwards; heads 15-100 per stem, campanulate, 30-90-flowered, on ultimate peduncles 1-6 cm. long; principal involucre bracts (4-)5-8 mm. long, 2-4 mm. wide, densely tomentose to nearly glabrate, yellow-membranous for about 1 mm. from the acute to rarely obtuse tip; corollas yellow, 2.5-3.5 mm. long, the tube glandular, 1.5-2 mm. long, the throat abruptly campanulate 1-1.5 mm. long, with lobes reflexed, 1-1.5 times longer than the lobes; achenes obpyramidal, 4-sided, 3-4.5 mm. long, evenly pubescent with hairs 0.5-1.5 mm. long; pappus of 16-22 linear oblong scales, 1-1.5 mm. long (very rarely less); anther usually completely exserted, 1.8-2.2 mm. long; $n = 17$.

DISTRIBUTION.—Gravelly, rocky, sandy or sandy limestone soils on intermontane plains of Trans-Pecos Texas, western New Mexico, eastern Arizona and adjacent areas of Mexico (Fig. 46). Flowering at two principal times: late April to May and again in late July to early August (Fig. 44), apparently depending on rainfall.

Hymenopappus flavescens var. *cano-tomentosus* can be distinguished from the closely related var. *flavescens* by its more finely dissected leaves with narrow segments and by its generally shorter pappus and involucre bracts. However, at the eastern periphery of its range, it intergrades almost completely with

var. *flavescens* (see discussion under that variety). Otherwise, it is essentially free of contamination from other taxa. As an exception is a single collection which seems to represent a clear hybrid between var. *cano-tomentosus* and some member of the *H. filifolius* complex (probably var. *cinereus* or var. *lugens*): Arizona. Navajo Co.: Kayenta, 1922, *John Weterill s.n.* (NY). The specimen is tall and leafy as is var. *cano-tomentosus*, but the leaves (which are obviously atypical) and the woolly stems approach those of *H. filifolius*. The inflorescence is apparently retarded in its development, being represented by a tight, abnormal cluster of heads at the stem apex.

REPRESENTATIVE SPECIMENS.—**Arizona.** APACHE CO.: Adamana, Sept. 1, 1909, *H. M. Rusby* (NY). GILA CO.: Tonto Hill, *Collom 163* (GH, MO, NY, US). GRAHAM CO.: between Safford and Globe, *Peebles 14601* (US). NAVAJO CO.: 14 mi. E. of Holbrook, *Goddard 698* (UC). PIMA CO.: Santa Catalina Mts., *Lemmon 218* (GH). **New Mexico.** BERNALILLO CO.: Albuquerque Mesa, *Castetter 1228* (RM). CATRON CO.: 8 mi. S. W. of Horse Springs, *Preece & Turner 2738* (SMU, WS). DE BACA CO.: Buchanan, Aug. 12, 1909, *Wooton* (US). DONA ANA CO.: Organ Mts., *Wooton 139* (DS, MO, NY, POM, RM, UC, US). EDDY CO.: 10 mi. W. of Hope, Aug. 4, 1905, *Wooton* (US). GRANT CO.: Whitewater Junction, Silver City Eastwood 8530 (CAS, GH). LUNA CO.: Nutt, *Diehl 751* (POM). SAN JUAN CO.: 45 mi. N. W. of Cuba, *Preece & Turner 2753* (SMU, WS). SOCORRO CO.: near Socorro, Aug., 1880 (1881), *H. H. Rusby 180* (MO, NY, WS). TORRANCE CO.: Willard, Aug. 26, 1904, *Wooton* (US). VALENCIA CO.: E. of Laguna Pueblo, *A. & R. Nelson 2176* (MO, RM). **Texas.** CULBERSON CO.: 2 mi. W. of Van Horn, *Waterfall 4409* (CAS, GH, MO, NY, SMU). ECTOR CO.: Odessa, *E. L. Reed 1907* (US). EL PASO CO.: El Paso, May, 1881, *G. R. Vasey* (DS, GH, US). HUDSPETH CO.: 32 mi. W. of Sierra Blanca, highway 62, on pipe line road, *Tharp 46149* (RM, RSA, UC). LOVING CO.: 10 mi. E. of Mentone, *Turner 984* (SMU). PRESIDIO CO.: 2 mi. W. of Marfa, *Warnock 5592* (SMU). REEVES CO.: Saragosa, *Warnock 5271* (SMU). WARD CO.: Barstow, *Earle & Tracy 43* (NY).

MEXICO. **Chihuahua.**: near Paso del Norte, *Pringie 759* (GH, MO, NY, UC, US).

(To be concluded)

LYGODIUM PALMATUM vs. URBANIZATION.--The climbing fern, *Lygodium palmatum* (Bernh) Sw., was once so plentiful within the limits of what is now the city of Hartford, Conn., that it was locally known as the Hartford Fern. But residents of Windsor, adjoining Hartford on the north, found it in such abundance there that they insisted on calling it the Windsor Fern. Citizens of both these communities recognized its commercial value and collected it extensively for ornamental display. The Connecticut Legislature, in an attempt to preserve it from extermination, passed a law in 1869 making it an offense punishable by fine for any person to gather it without the consent of the owner on whose property it was growing. This law is still on the statute books of Connecticut.

Despite this legal attempt at its preservation the advance of civilization caused human habitations to occupy the habitats of these ferns, so that for a quarter century or more no plant of this fern has been found growing wild in either Hartford or Windsor. *Lygodium palmatum* is now so rare in the Connecticut valley that even professional botanists confess that they have never seen it growing in its natural surroundings; and nurserymen in Connecticut, Massachusetts and Vermont offer it for sale as a rare species.

Gray's Manual (8th edition) states that its range extends from Georgia north to southeast New York, southern New England, and west to Ohio and Kentucky. It would be of interest to both botanists and conservationists to have a report from the states outside New England as comprehensive and authoritative as that given by Dr. Shaver in his "Ferns of Tennessee." He also notes its appearance at four stations in Great Smoky Mountains National Park in West Virginia. Such a report would indicate to what extent this fern is withstanding the attacks of civilized humanity.

Herewith is a partial report of its status in the Connecticut Valley based on observations covering the last decade.

A small colony was discovered in a wooded area in Granby, Ct. by Mrs. Harry L. Oppenheimer, of Suffield, Conn., in 1950. Since that date the owner of the property has cleared his acres for building sites and eradicated the fern.

A similar colony was discovered in Wilbraham, Mass., near the Springfield line, and reported to me by Mr. R. A. Doray, of Greenfield, Mass. This station I visited in 1950, but I noted that it was very close to the highway and that the city was extending its tentacles dangerously near to the spot. On my last visit, in October 1955, I found one of these modern houses (two bedrooms and a two-car garage) occupying the site.

Mr. Doray reports that as recently as 1953 a sizeable colony persisted in a swamp off Tinkham Road, Springfield, a short distance from Wilbraham Road. Another station, in a pasture in North Amherst near the road to Sunderland, is apparently not yet threatened by real estate developments.

In the spring of 1955 Mr. Percy E. Fellows of Wethersfield, Conn. brought me a spray of the fern which he had found close to the highway in Rocky Hill, Conn. On visiting that spot some weeks later, all vegetation, including the fern, had become a ghastly brown, the result of spraying along the highway by the State Highway Department in its successful effort to destroy roadside weeds. Whether the fern will survive this treatment and make another attempt to survive next spring is problematical.

In Granby, Conn., along an abandoned wood road, a small colony was discovered in 1954. This station is known to the discoverer only. Also in Granby is another small colony on property owned by Johnson's Nursery of Southwick, Mass. This station is being perpetuated for commercial purposes and will be well guarded by the owner.

Near the Granby line, in Suffield, Conn., another colony was discovered in 1952. This is on property owned by a fern-lover who is determined to preserve this fern from destruction. Its location is known only to a few high-minded botanists. Its site will be revealed in the future only to those who respect the laws of Connecticut, who share the owner's desire that no plant shall be molested, and are content to observe the modified adage: "a fern in the wood is worth two in the hand."

It is high time that botanists, fern-lovers and conservationists throughout the country enter into a compact to save this lone American species of *Lygodium* from extermination.—JESSE F. SMITH, SUFFIELD, CONN.

CLARENCE R. HANES.—The death of Mr. Hanes on February 10, 1956, brought to a close the career of one of Michigan's most active field botanists. Clarence Robert Hanes was born March 26, 1874, in the family home in Schoolcraft, Michigan, where he lived for the rest of his life (except while away at school). He farmed the family property in the vicinity, and was very active in civic affairs. Upon graduation from Schoolcraft High School, where he concentrated in languages, he continued his studies at the University of Michigan, from which he graduated in 1898. In 1911, he married Florence Nutten, who later shared with him a quarter century of intensive study of the local flora.

Started as an avocation in the early 1930's, the Hanes' floristic work was originally limited to the area within five miles of their home in Schoolcraft, Kalamazoo County, Michigan. Botanical authorities to whom they sent some of their unusual finds urged that they extend their study to the entire county. Subsequent years of thorough field work culminated in the publication of their flora of the county in 1947.¹ This remains the finest county flora yet produced for the state of Michigan—and one of the few really good local floras for the entire Great Lakes region. Until Mr. Hanes' death, he and his wife continued their collecting, with additional work in other counties of western Michigan. Mrs. Hanes, who did all of the mounting for the herbarium in addition to sharing fully in the field work, has been completing the mounting of some recent collections from other counties.

Much of the area about Schoolcraft was covered by Mr. Hanes on his bicycle, while their old farm truck carried them to more distant areas. Other Kalamazoo County residents whose collections and interest aided the Hanes' studies included H. R. Becker (who also died in February), Dr. L. A. Kenoyer of Western Michigan College, and Fred W. Rapp. The herbarium contains many critical species determined by specialists to whom material was sent. Of particular significance was Hanes' collaboration with Liberty Hyde Bailey on the genus *Rubus*, over 20 new species of which were described by Bailey from Kalamazoo County (including *R. hanesii*, *R. florenceae* [named for Mrs. Hanes], *R. schoolcraftianus*, and *R. kalamazoensis*). Another

¹ CLARENCE R. HANES AND FLORENCE N. HANES, *Flora of Kalamazoo County, Michigan. Vascular Plants*. Schoolcraft, Michigan, 1947. xii + 295 pp. (Reviewed in *Rhodora* 49: 143-144. 1947.)

valuable collaboration was with F. J. Hermann on the genus *Carex*, many new county and state records having resulted from the Hanes' field work in southwestern Michigan.

The Hanes herbarium has been given to Western Michigan College in Kalamazoo, where it is housed in the "Clarence R. Hanes Room," dedicated May 2. The herbarium is to be kept as a unit, neither being distributed among other collections nor having additions inserted, until such time as a flora of Michigan is published. Given with the herbarium was a large record book in which notes and observations are recorded geographically, by the various localities in the vicinity.

The discoverer of many species previously unknown from Michigan, Mr. Hanes published his findings primarily in the *Papers* of the Michigan Academy of Science, Arts, and Letters. He also submitted a number of notes to RHODORA, of which the most recent was published in January, 1956.—EDWARD G. VOSS AND JAMES S. WILSON, UNIVERSITY OF MICHIGAN, ANN ARBOR.

FLORA OF WINNEBAGO COUNTY, ILLINOIS¹.—Local floras are valuable as supplements to state and regional floras. By confining their data and subject matter to the local vegetation, they emphasize many aspects of a flora that are lost or otherwise not evident in state and regional manuals. Local floras furthermore reflect the intensive concentrated work of an enthusiastic botanist who has devoted all his spare moments to these interests. To such a category of devout enthusiastic workers Dr. Fell belongs. By profession a physician, his avocational interest throughout his life has been centered on the collecting and study of the native flora of this northern Illinois county, in which the city of Rockford is located.

The present volume represents the results of a life time of study and is an admirable contribution to add to other recent works relating to the Illinois flora. Actually, it is an expanded treatment of the Check list of the vascular plants of Winnebago County, Illinois, published in 1949 (Trans. Ill. Acad. Sci. 42: 68-79) by George D. Fuller, E. W. Fell, and G. B. Fell.

The book under review is packed with the type of phytogeo-

¹ FELL, EGBERT W. Flora of Winnebago County, Illinois. Nature Conservancy, Washington, D. C. 1-207, illustrated. 1955.

graphical and ecological information which furnishes the reader with data he could not easily find elsewhere if at all. In addition to such topics as climate, geology and physical features, types of habitats within the county, there are interesting units discussed under the distribution of species, and plant refuges. The discussion of the last topic reflects Dr. Fell's profound intimacy with the flora of the region. Altogether, 1210 species of vascular plants (ferns and flowering plants), of which 1013 are native, are treated in the flora. The data are based upon the extensive herbarium specimens collected by Dr. Fell, as well as upon those of M. S. Bebb, Evelyn I. Fernald, and various other local botanists and collectors. Eighty seven illustrations of various species, five photographs representing different kinds of habitats, one photograph of M. S. Bebb, a map of Winnebago County showing distribution of prairie and woodland, and of names of places mentioned in the flora, and a detailed index serve to widen the usefulness of the book.

Categories below the species level are not recognized, a practice with which many botanists will not be in agreement. The adherence to "species only" concept has led to the maintenance of *Botrychium dissectum* and *B. obliquum*, and of *Dryopteris spinulosa* and *D. intermedia* as distinct species, whereas most fern students have treated these as forms or varieties. Again, this style has led to the listing of *Lespedeza longifolia* DC. as a distinct species. However, as brought out in the eighth edition of Gray's Manual, *L. longifolia* DC. is a little known eastern plant, and the proper position of it is in varietal rank under *L. hirta*. It has no close taxonomic relationship with *L. capitata*, with which Dr. Fell has indicated it as "*(L. capitata* var. *longifolia*)."

Many other similar cases could be specified, but this does not detract greatly from the general usefulness of the work.

Dr. Fell is to be congratulated for having brought out this splendid book, which definitely fills an important gap in the literature on the local flora and on Illinois plant geography and ecology.—JULIAN A. STEYERMARK, CHICAGO NATURAL HISTORY MUSEUM, CHICAGO, ILLINOIS AND MISSOURI BOTANICAL GARDEN, ST. LOUIS, MISSOURI.

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